Short communication

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New locality records of invasive freshwater jellyfish *Craspedacusta sowerbii* (Lankester, 1880) in Türkiye

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ABSTRACT. Invasive jellyfish *Craspedacusta sowerbii* (Lankester, 1880) is a hydrozoan (Phylum Cnidaria, Class Hydrozoa), most easily identified in its hydromedusa form as a small, bell-shaped jellyfish. Indigenous to the Yangtze River valley in China, this species has spread across temperate climates, including Türkiye, for over a century. In this study, three new locality records were discovered in Türkiye: Umurbey (Çanakkale), Geyik (Muğla), and Seyhan (Adana) dams. Some physicochemical parameters (pH, dissolved oxygen, temperature and electrical conductivity) of the sampling points were measured. Although there is no definite information on the origin of this species in the dams, it is thought that it is hypothesized that it may have been introduced by fish stocking, aquatic birds and human activities.

Keywords: Hydrozoan, Muğla, Çanakkale, Adana, Invasiveness

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1. Introduction

Currently, numerous species are voluntarily or involuntarily relocated outside their natural or potential distribution areas for various reasons, including aquaculture, research, biological control, bio-manipulation, sport fishing, replenishment of declining stocks or ballast water releasing ornamental fishes deliberately or unintentionally (Lockwood et al., 2007; Çiçek et al., 2022). A range of anthropogenic factors, such as global warming, climate change, pollution, unintentional water consumption, eutrophication, and urbanization, present significant challenges to the integrity and biodiversity of aquatic ecosystems. These factors facilitate the spread of non-native species and support the establishment of large populations in new areas (Galil et al., 2014; Mannino et al., 2017).

Globally, over 20 species of freshwater jellyfish exist, with *Craspedacusta sowerbii* (Lankester, 1880) being the most widespread. This small freshwater hydrozoan cnidarian, originally from the Yangtze River region in China, has now spread to many regions worldwide (Kramp, 1950). *Craspedacusta sowerbii* is typically found in natural lakes but is more commonly present in dams and ponds (Augustin et al., 1987). Hydrozoans have two adult forms: polyps and medusae. Polyps can develop a protective membrane called the podocyst, allowing them to withstand prolonged food shortages and extreme conditions. When conditions become favorable, podocysts revert to polyps. This adaptive ability allows the species to colonize various freshwater habitats (Bouillon and Boero, 2000; Lucas et al., 2013).

The first record of *C. sowerbii* in Türkiye was documented by Dumont (1994) from Keban Dam Lake. Subsequent records include Balık et al. (2001) from Topçam Dam Lake, Bozkurt (2004) from Kozan Dam Lake, Bekleyen et al. (2011) from Kıralkızı Dam Lake, Akçaalan et al. (2011) from Sapanca Lake, Gülşahin (2017) from Ula Pond, Kutlu (2020) from Uzunçayır Dam Lake, Özbek and Sömek (2020) from Ürkmez Dam Lake and Killi et al. (2021) from Akdeğirmen and Ataköy Dam Lake.

Recently, several studies have been focused on new localities and mapping the spatial distribution of *C. sowerbii*. In this study, the presence of *C. sowerbii* was discovered for the first time in the Geyik (Muğla), Umurbey (Çanakkale), and Seyhan (Adana) Dam lakes.

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2. Material and Method

2.1. Study area

The sampling studies were conducted in 2022 at the following locations: Geyik (37.405760N, 27.87983E), Umurbey (40.243824N, 26.676228E), and Seyhan (37.074054N, 35.272088E) dam lakes.

The Umurbey Dam, constructed in 2003, aims to facilitate irrigation on the Umurbey Stream, located within the boundaries of Çanakkale province in the Marmara basin. This dam covers a surface area of 213 km^2 and is fed by three rivers. It is in 55 meters depth.

Geyik Dam, was constructed in 1998, provides drinking water in the Western Mediterranean basin on Sarıçay in Milas district of Muğla province. The dam has a surface area of 320 km^2 and is fed by three river sources. The depth of the dam lake is 12 meters.

Seyhan Dam, was builted in 1956 in the Seyhan basin, serves the dual purposes of agricultural irrigation and electricity generation. The dam stands at 67 meters above sea level, with the deepest point reaching approximately 45 meters. The lake's surface area of the lake varies seasonally, averaging around 53 km^2 (Fig. 1).

2.2. Physicochemical analysis and sampling

Water samples were collected to measure environmental parameters at three locations within the dam lakes from the bottom, middle, and surface waters. Samples from the surface and bottom of the dam were collected using a Nansen bottle. Light transmittance was determined with a 30-centimeter diameter Seki disk. In situ measurements of temperature (°C), salinity (ppt), dissolved oxygen (mg/L), electrical conductivity (µS/cm), and pH parameters were taken using a Hach Lange HQ 40 D multi-parameter.

To determine the current distribution of *C. sowerbii*, a review of the relevant literature was conducted, and a map was created for each locality (Fig. 1). The taxonomic identification of the medusa was performed using the methodology proposed by Jankowski (2001) with a Leika EZ-4D stereomicroscope. The density of individuals was calculated in situ through instantaneous observations over an area of approximately one square meter.

3. Result and Discussion

This study presents additional records of *C. sowerbii* from freshwaters bodies in Türkiye (Fig. 2). A dense population was found in Geyik Dam Lake in September 2022 with 9 individuals/m^2 in the dam lake with bell diameters ranging from 1.5 to 3.2 cm. In October 2022, a smaller population was found in Umurbey Dam, with 2 individuals/m^2 with bell diameters between 1.4 and 1.9 cm. In Seyhan Dam Lake, 3 individuals/m^2 were observed in September 2022 with bell diameters ranging from 1.3 to 2.1 cm.

Physicochemical parameters of the sampling points are in Table 1. It found that the optimum temperature range for *C. sowerbii* is between 19 and 30 °C (Dunham, 1941; Reisinger, 1957; Lytle, 1959; Acker and Muscat, 1976). However, some studies have observed medusae at lower temperatures (Milne, 1938; Killi et al., 2021). This demonstrates the species' high tolerance to varying environmental parameters. The formation of medusae is influenced by nutrient abundance and temperature (Matthews, 1966).

The density of *Craspedacusta sowerbii* is significantly influenced by factors such as dissolved oxygen, pH, electrical conductivity, and water transparency. In Geyik Dam Lake, low dissolved oxygen (6.7 mg/L), low pH (7.94), and low electrical conductivity (160 µS/cm) may provide a competitive advantage for the species, while the low Secchi depth (1.5 m) suggests high phytoplankton productivity, potentially enhancing food availability. In contrast, Umurbey Dam Lake, characterized by the highest dissolved oxygen (8.2 mg/L), the highest pH (8.46), and the greatest water transparency (5.9 m), presents a more stable and oxygen-rich environment; however, lower planktonic productivity may make it less favorable for the species. Seyhan Dam Lake, with moderate values across parameters, represents a relatively balanced ecosystem, while its highest electrical conductivity (387 µS/cm) indicates a higher concentration of nutrients, poten-

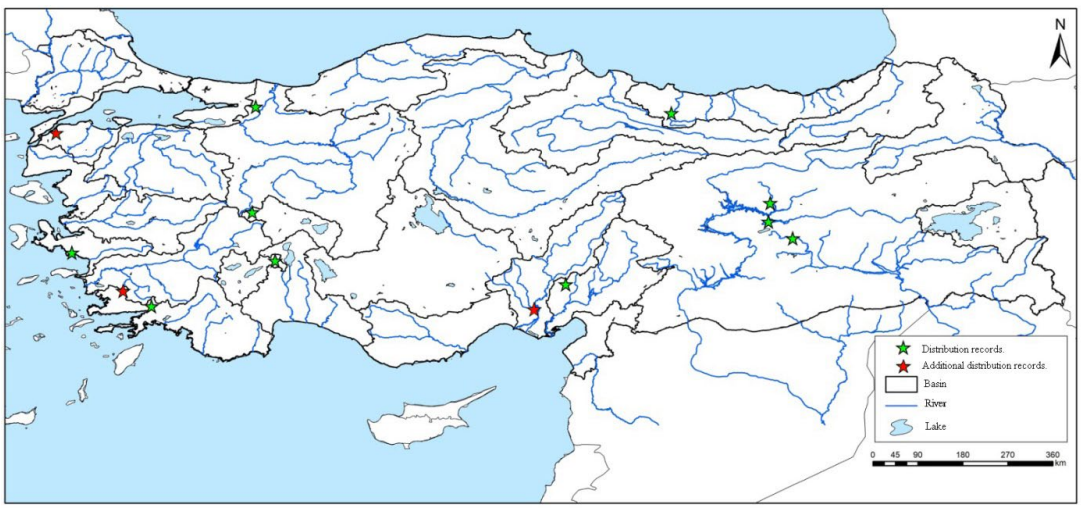

Fig.1. Distribution map of *Craspedacusta sowerbii* in Türkiye.

Table 1. Ecological parameters of sampling stations (DO: Dissolved Oxygen; Temp: Temperature; EC: Electical conductivity)

Station	Parameters					
	DO (mg/L)	Temp (°C)	EC (µS/cm)	pH	Depth (m)	Secchi depth (m)
Umurbey Dam Lake	8.2	18.2	136	8.46	55.0	5.9
Seyhan Dam Lake	8.1	24.4	387	8.23	24.0	5.0
Geyik Dam Lake	6.7	26.6	160	7.94	8.0	1.5

tially supporting greater zooplankton abundance and improving food accessibility for *C. sowerbii*. These findings underscore the critical role of physicochemical water properties in directly shaping the distribution and density of this species.

Anthropogenic impacts on aquatic ecosystems lead ecological degradation, with invasive species exacerbating these disturbances. Increased ecological disturbances facilitate the easier entry of invasive species into aquatic ecosystems (Perdikaris et al., 2010). Especially in fragile areas already inhabited by invasive species, new invasions occur even more rapidly. This is one reason for the high population density observed in Geyik Dam. The region has been invaded by *Lepomis gibbosus* (Linnaeus, 1758), an invasive inland fish; *Dreissena polymorpha* (Pallas, 1771), a highly invasive mussel; and *Elodea canadensis* Michx., an aquarium plant that has become invasive due to its relocation to different regions (personal observation). It is expected that a new invasive species would enter Geyik Dam, which is which is vulnerable to invasions, and establish large populations. In addition to its susceptibility to invasive species, the high air temperature and nutrient availability create a favorable habitat for *C. sowebii*.

The study conducted at Umurbey Dam in October revealed that the water temperature was lower than in other dams, and the nutrients levels in the reservoir were also lower compared to Geyik Dam. However, interviews with local fishermen indicated that *C. sowerbii* was much more abundant in August than it is currently.

In the context of biological invasion, identifying the exact entry-dispersal vectors and pathways is challenging. Nevertheless, primary methods of spread include biological control, research, recreation, and the augmentation of declining aquatic bird populations. Proposed vectors proposed for the dispersal of *C. sowerbii* are aquatic birds, aquatic plants, and human activities (Lockwood et al., 2007; Morpurgo and Alber, 2015). Dumont (1994) highlighted the significance of avian migration routes for *C. sowerbii*, citing the presence of podocysts. The irregular and counterintuitive global distribution of different lineage groups of *C. sowerbii* on underscores the importance of the bird migration route hypothesis. However, further detailed studies are needed to substantiate this hypothesis. Based on current evidence, it can be concluded that Seyhan Dam (Adana-Seyhan) serves as a primary migration route, while Umurbey Dam (Çanakkale-Lapseki) and Geyik Dam (Muğla-Milas) constitute secondary migration routes (Kiziroğlu, 2009). The Tuzla wetland in Muğla/Milas is an important important habitat for migratory birds, and the present distribution of this species aligns with the migratory patterns, substantiating Dumont's hypothesis.

Fig.2. *Craspedacusta sowerbii* sample from Geyik Dam Lake.

The detection of *Craspedacusta sowerbii* in three new localities in Türkiye has increased the total number of recorded sites to 13. This invasive freshwater jellyfish primarily preys on zooplankton, disrupting planktonic equilibrium and intensifying resource competition for larval and juvenile fish, potentially reducing their growth rates. The decline in zooplankton populations, coupled with an increase in phytoplankton biomass, may accelerate eutrophication and degrade water quality. Additionally, the competitive advantage of *C. sowerbii* may threaten endemic or narrowly distributed species, posing a significant risk to biodiversity by altering trophic interactions and ecological stability.

This invasion may also have severe implications for ecosystem services. The decline in fishery productivity could result in economic losses, while deteriorating water quality may limit its use for drinking and irrigation. Furthermore, recreational activities in affected freshwater bodies could be negatively impacted by high jellyfish densities. To mitigate these effects, long-term ecological monitoring, environmental DNA (eDNA) analysis, and the development of strategic management plans to preserve local ecosystems are imperative.

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Conflict of interest

The authors declare no conflicts of interest.

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